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Etiological profile, clinical course immediate outcome and short term follow-up of anemia in newborn

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Abstract

Background and objectives: Neonatal anemia is one of the most common hematological problems encountered in NICU. We designed a study to determine the etiological profile, clinical course, immediate outcome and short term follow up of anemia in new born. **Methods:** 62 neonates admitted in NICU with hemoglobin < 14 gm % or who develop anemia during stay in NICU in one year period were included in our study. The association of anemia with various variables and the immediate outcome was studied. The clinical course of the anemic neonates was observed and followed up over a period of 6 months. The outcome was assessed. Data were analysed using statistical software SPSS 14.0. **Results:** The prevalence of anemia was 10.76% in our NICU. The most common etiologic association with anemia was septicemia (53%). Other common etiologies were iatrogenic blood loss (20%), Rh incompatibility (8%), ABO incompatibility (8%), VKDB (6.4%). Common symptoms and signs are poor feeding (32.2%), jaundice (24.1%), hurried breathing (22.5%), lethargy (17.7%), pallor (30.6%), tachypnea (24.1%) and increased oxygen requirement (20.9%). 37% of anemic neonates needed blood transfusion. Mortality was higher in preterm babies. Overall immediate outcome was satisfactory in 59.7%. Hemoglobin reached nadir of 9.7gm% at 3 months of age. Overall neurodevelopmental outcome was good in 42.3% of cases. Interpretation and conclusion: Neonatal anemia is a common neonatal hematological problem. Preterm babies underwent significantly large amount of iatrogenic blood loss (p<0.05). Blood transfusion significantly reduced heart rate, respiratory rate, increased SPO_2. There was no significant difference between immediate outcome between preterm and term anemic neonates. Maternal anemia was significantly associated with lower hemoglobin levels at 6 months of age. Babies born via cesarean section had significantly lower levels of hemoglobin at 6 months. There was no association between birth weight, gestational age and hemoglobin level at admission. Tight nuchal cord was not associated with significantly lower level of hemoglobin. Delayed cord clamping did not show significantly increased levels of hemoglobin.
Keywords: Hemoglobin; anemia; neonate; neonatal intensive care unit; transfusion.

Introduction

Hemoglobin (Hb) value of less than 14gm% at birth on properly taken blood sample regardless of gestation in any neonate is considered as anemia[1]. In neonates admitted to hospital the most common cause of anemia is blood loss secondary to iatrogenic blood letting[1].

Anemia is a common neonatal hematological problem. It is characterized by an abnormally low red cell mass. In clinical practice "hemoglobin concentration" is assumed to reflect the circulating red cell mass. Anemic state is defined if low level of hemoglobin concentration is present. Anemia in the neonatal period is complex subject. This is because neonates have unique blood picture and also have normal variation in hematological parameters. One more reason is that in no other period of life anemia is known to occur due to such varied causes. Neonatal anemia is the most common indication for blood transfusion in intensive care unit. The frequency of transfusion is increased with decreasing birth weight, gestation and sicker infants. Most of the time hemoglobin alone is taken into account for transfusion. So while discussing the causes and problem of neonatal anemia, emphasis is also given on measures to prevent or minimize it.

A lot of research articles have been published in the past regarding the etio-pathogenesis, clinical presentation, assessment and management of this problem, anemia in the newborn[2,3,4].

The effect of anemia on the outcome of newborn is a subject that has not been studied in detail in the past.

After a detailed search of the indexed medical literature, it was found that there have been only few articles on this topic from India[5].

The paucity of studies from India especially from southern India and the increasing prevalence of this condition in our Neonatal Intensive Care Unit (NICU), made us to take up a study that would assess the etiology, clinical features, outcome of anemia in newborn, in cases admitted to our NICU.

Objectives

1. Our study is aimed at finding out the etiological profile of the neonate admitted with anemia (Hb level < 14 gm %) in KIMS, NICU.
2. To study the clinical course of anemia.
3. To study the immediate outcome and short term follow up of anemic neonates.

Methodolgy

The present study was done to know the etiological profile, clinical course, immediate outcome of neonates admitted to the NICU with anemia and a short term follow up of 6 months, to study its outcome. Further assessments of the factors predisposing to anemia were evaluated.

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Source of data

Sixty two neonates admitted to the NICU of Kamineni Institute of Medical Sciences, Department of Pediatrics, Narketpally, during the period of March 2018 to February 2019 with diagnosis of anemia formed study group. All the neonates were followed up after their discharge for a period of 6 months. The neonates who were lost for follow up were excluded while assessing outcome.

Study Design and Inclusion criteria

It is one year cross sectional observational study of anemic neonates admitted in NICU.

Inclusion criteria

Neonates admitted to NICU from March 2018 to February 2019 and who satisfied all the three criteria were included in the study.
1. Neonates (both term and preterm) from birth to 28 days of life, admitted inNICU for any clinical problems.
2. Hemoglobin level < 14 gm% at admission or during the course of stay in NICU
3. Birth weight > 1 kg

Exclusion criteria

1. Infants with lethal congenital anomalies.
2. Severely ill infants, resuscitated with volume expanders at admission or those who survived for < 24 hours from admission time.
3. Infants with previous history of blood transfusion.
4. Infants with previous history of exchange transfusion.
5. Babies with gestational age < 28 weeks or birth weight < 1 kg.

Method of collection of data

At admission the parents and / or the guardian were informed about the study. An oral informed consent was obtained. A detailed history, inclusive of maternal history and obstetric history with a focus on history that predisposes to anemia in newborn was obtained as per the proforma. Information regarding a number of conditions that have been implicated by past studies to be associated with neonatal anemia was prospectively recorded.

A history of maternal anemia, PIH, antepartum hemorrhage, gestational diabetes mellitus were asked for. These diagnosis were made as per standard diagnostic criteria laid down. Other history regarding gravida status, mode of delivery, mothers blood group, foul smelling liquor, cord around the neck were also recorded. The time interval between the birth of the baby and clamping the cord was noted in hospital born babies. Gestational age of all neonates was determined basedon New Ballards scoring System.

Growth assessment at birth or admission to detect intrauterine growth restriction was based on colorado intrauterine growth charts. Every neonate had a detailed physical examination as mentioned in the proforma. All neonates at admission underwent a gastric lavage to look for any altered blood in the aspirate. Maternal blood was differentiated from neonatal blood using the Apt test. The amount of blood drawn for investigations was noted each time by using marked tubes.

All the neonates underwent necessary investigations
1. Complete blood count.
2. Blood group and Rh type.
3. Peripheral smear study
4. Blood culture
5. Septic work up (absolute neutrophil count, total WBC count, micro ESR, Creactive protein)
6. Serum bilirubin
7. Direct Coomb's test
8. G-6 – PD status
9. Arterial blood gas analysis

Follow up

All neonates were followed up at least once in two weeks for a period of 6 months. In each visit a detailed physical examination was done. Weight and head circumference were measured and plotted on the Agarwal growth and development chart for affluent Indian Children (1994)[6].

Growth parameters at a point of time lying below the 3rd percentile wasconsidered to be abnormal.

Neurodevelopment was assessed using Denver II scale. It is not designed to be an IQ test nor it can generate diagnostic labels such as learning disability, language disorder etc… Rather the test is designed to compare a given child's performance on a variety of tests to the performance of other of the same age. Denver II consists of 125 tasks / items which are arranged on the test forms in 4 sectors[7].

Table 1. Definition of various outcome

Outcome	Denver II	Weight and/or head circumference
Good (g)	Normal (N)	□ 3rd centile
Fair (f)	Normal	< 3rd centile.
Poor (p)	Suspect (S)/ expired	< or > or = 3rd centile (irrespective of their growth).

Statistical analysis

Descriptive data are presented as number, percentages, mean or standard deviation. Comparison of the groups for categorical variables was done by using chi square test. Continuous variables were analysed using unpaired two tailed t test. Multiple groups comparisons were done by one way analysis of variance (ANOVA). A 'p' value below 0.05 was considered significant. All the data were analysed using statistical software SPSS (version 14.0, USA).

Results

A total of 576 neonates were admitted in the NICU during our study period and 62 anemic neonates were included in our study as per inclusion and exclusion criteria laid down.

Table 2 : Categorization of neonates according to postnatal age in days

Age (days)	Frequency	Percentage
<7	39	62.9
8 - 14	6	9.7
15 – 21	3	4.8
22 – 28	14	22.6
Total	62	100

39 (62.9%) of 62 anemic neonates admitted in NICU were under the age of 7 days and 14 (22.6%) of infants were between 22 and 28 days. 6 (9.7%) neonates were aged between 8 and 14 days and 3 (4.8%) neonates were aged between 15 and 21days.

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Table 3 : Categorization of neonates according to their birth weight and meanhemoglobin level

B. Wt (in Kg)	Frequency	Percentage
1-1.99	15	24.2
2-2.99	35	56.5
3 and more	12	19.4
Total	62	100

35(56.5%) babies weighed between 2 and 2.99 kg, 15 (24.2%) babies weighed between 1 and 1.99 kg and 12 (19.4%) babies weighed 3 kg or more. Out of these 62 neonates, 83.8% were AGA, 14.5% were SGA, 1.6% were LGA. However there is no significant association between the birth weight and hemoglobin level. (p > 0.05)

Table 4: Categorization of neonates according to their gestational age

Gest. age (in weeks)	Frequency	Percentage
<37	21	33
>37	41	67
Total	62	100

41(67%) out of 62 infants were term infants with gestational age more than 37 completed weeks. Mean Hb of preterm babies < 37 wks was 12.01 ± 3.1gm% and for term babies(> 37 wks) was 11.45 ± 3.0 gm%. However the difference was not statistically significant (p > 0.05).
Out of 62 neonates 42 (67.7%) were males and 20 (32.2%) cases were female neonates.
Maternal factors like anemia was seen in 33(53.2%) mothers, PIH in 4(6.5%), APH in 2(3.2%), DM in 1(1.6%)mothers of anemic neonates.

Table 5 : Association between mode of delivery and hemoglobin levels atadmission and at 6 months of age

Mode of delivery	Frequency	Percentage	Hb at admission	Hb at 6months.
Cesarean	21	33.9	11.9 - 3.28	10.1 - 0.6
Vaginal	41	66.1	11.5 - 2.9	10.5 - 0.8
	62	100	t= 0.49 p > 0.05, NS	t= 2.39 p < 0.05, Sig

Although the Hb levels of babies born by cesarean section were higher than the babies born via vaginal delivery, it was not statistically significant (p > 0.05). However the same babies born via cesarean section were having lower Hb at 6 months of age, which was statistically significant (p < 0.05). Babies born via vaginal delivery had higher levels of hemoglobin at 6 months of age.

Table 6 : Association between maternal and neonatal Hb levels

Mat. Hb levels	Frequency	Percentage	Hb at adm.	Hb at 6mo.
< 11	33	53.2	11.4 - 3.0	10.1 - 0.7
> 11	29	46.2	11.9 - 3.2	10.5 -0.6
			t = 0.63 p > 0.05, NS	t = 2.42 p < 0.05, Sig

Average Hb of babies born to anemic mothers was 11.4 - 3gm%, although it was less than babies born to non anemic mothers it was not statistically significant (p > 0.05). However Hb level at 6 months was also lower in babies born to anemic mothers which was statistically significant (p < 0.05).

Table 7 : Association between tight nuchal cord and Hb levels

Tight Nuchal cord	Frequency	Percentage	Hb at admission	Hb at 6months
Present	7	11.3	11.9 - 2.1	10.1 - 0.6
Absent	55	88.7	11.6 - 3.2	10.4 - 0.8
			t = 0.31 p > 0.01, NS	t = 0.89 p > 0.05, NS

7 (11.3%) out of 62 anemic neonates had tight nuchal cord. The average Hb level of neonates with tight nuclal cord was 11.9 - 2.1gm%, the difference was statistically not significant (p > 0.05). The average Hb level of babies with tight nuchal cord was 10.1 - 0.6gm% compared to babies with no nuchal cord, which was 10.4 - 0.8gm%. This was statistically not significant (p > 0.05).

Table 8: Association between cord clamping and Hb levels

Cord clamping (in seconds)	Frequency	Percentage	Hb at admission	Hb at 6months.
< 30	34	60.7	11.6 - 3.1	10.2 - 0.7
> 30	22	39.2	11.8 - 3.0	10.6 - 0.8
Total	56	100	t = 0.24 p > 0.05, NS	t = 1.92 p > 0.05, NS

34 (60.7%) neonates with early cord clamping had average Hb 11.6 - 3.1gm% and 10.2 - 0.7gm% at admission and at 6 months of age respectively. Although in both the occasions Hb level was lower in early cord clamping it was not statistically significant (p > 0.05).

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Table 9 : Association between APGAR score and Hb level

APGAR	Frequency	Percentage	Mean - SD
- 7	22	39	12.2 - 3.0
- 8	34	61	11.3 - 3.2
Total	56	100	
			t = 1.12 $p > 0.05$, NS

22(39%) out of 56 neonates had APGAR - 7 at 5 minutes and 34(61%) neonates had -8 at 5 minutes. The mean Hb was 12.2 - 3.0gm% and 11.3 - 3.2gm% respectively. The difference was not significant statistically ($p > 0.05$).

Table 10 : Symptoms of anemic neonates

Symptoms	Frequency	Percentage
Lethargy	11	17
Poor feeding	20	32.2
Hurried breathing	14	22.5
Abdominal distension	3	4.8
Fever	5	8
Convulsion	6	9.6
Jaundice	15	24.1
Failure to thrive	2	3.2
Vomiting	5	8

Poor feeding was seen in 20 (32.2 %) of the cases followed by Jaundice in 15(24.1%). Hurried breathing in 14(22.5%), lethargy in 11(17%). Convulsions in 6 (9.6%), fever in 5(8%), vomiting in 5(8%) of the cases. Most commonly seen symptom was poor feeding.

Table 11 : Signs of anemia in neonates

Signs	Frequency	Percentage
Pallor	19	30.6
Tachypnea	15	24.1
Increase in O_2 requirement (- 7 days)	13	20.9
Icterus	15	24.2
Tachycardia	10	16.1
Apnea	5	8
Lethargy	11	17.7
Hepatosplenomegaly	3	4.8
Bleeding	13	20.9
CFT > 3 Sec	8	12.9
Shock	2	3.2

Most common sign was pallor, seen in 19(30.6%) cases, followed by icterus in 15(24.2%), tachypnea in 15(24.1%), increased oxygen requirement in 13(20.9%), bleeding in 13(20.9%), lethargy in 11(17.7%), tachycardia in 10(16.1%), CFT > 3 see in 8(12.9%), apnea in 5(8%) hepatosplenomegaly in 3(4.8%), shock in 2(3.2%)cases.

Table 12: Etiologic classification of anemic neonates

Etiology	Frequency	Percentage
Rh incompatibility	5	8
ABO incompatibility	2	3.2
Septicemia	33	53
DIC	2	3.2
VK DB	4	6.4
Iatrogenic blood loss	13	20
ICH	2	3.2
Subgaleal hemorrhage	1	1.6
	62	100

Septicemia is seen in 33(53%) of the anemic infants, which is the most common etiology followed by iatrogenic blood loss, which is seen in 13(20%) of the infants. Rh incompatibility was seen in 5(8%) cases, VKDB in 4(6.4%) cases. ABO incompatibility, DIC, ICH were seen in 2(3.2%) cases each. Subgaleal hemorrhage was seen in 1(1.6%) case.

Table 13 : Amount of blood drawn in relation to gestational age

Gest. Age(In weeks)	Frequency	Amount of blooddrawn (Mean - SD)	Percentage ofblood drawn (Mean - SD)
< 37	21	10.5 - 2.5	7.0 - 1.8
> 37	41	9.4 - 3.8	4.4 - 2.5
		t = 1.20 $p > 0.05$, NS	t = 4.58 $p < 0.05$, Sig

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The preterm babies less than 37 weeks had sampling loss of 10.5 - 2.5 ml, compared to term babies, in which it was 9.4 - 3.8 ml. This was equivalent to 7% of their blood volume in preterm babies and 4.4% of their blood volume in term babies. This difference was statistically significant (p < 0.05).

Table 14 : Amount of blood drawn in anemic and non anemic neonates

Hb level at admission (in gm%)	Frequency	Amount of blood drawn in ml.
< 14	49	8.9 - 2.8
> 14	13	13.1 - 3.6
		t = 3.97 p < 0.05, Sig

Babies with Hb > 14 gm%, who developed anemia later in course in NICU had iatrogenic blood loss of 13.1 ☐ 3.6 ml, which was statistically significant (p < 0.05).

Table 15 : Anemic neonates and blood transfusions

Blood Transfusions	Frequency	Percentage
Yes	23	37
No	39	63
Total	62	100

23(37%) of 62 neonates received blood or packed cell transfusion. 39(63%) neonates did not receive blood transfusion.

Table 16: Effect of blood transfusion on heart rate (HR)

HR before Blood. Transfusion	HR after Blood. Transfusion	Reduction
152.3 ☐ 10.1	144.9 - 7.9	7.4 - 5.9
		t = 6.75 p < 0.01, Sig

Average HR before transfusion was 152.3 - 10.1 beats per minute (bpm). It reduced by 7.4 - 5.9 bpm after blood transfusion and average HR after blood transfusion was 144.9 - 7.9 bpm, which was statistically significant (p < 0.01).

Table 17 : Effect of blood transfusion on respiratory rate (RR)

RR before Blood. Transfusion	RR After Blood. Transfusion	Reduction
51.1 - 10.9	49.2 - 9.3	1.9 - 4.0
		t = 2.50 p < 0.05, Sig

The average respiratory rate of anemic infants before blood transfusion was 51.1 - 10.9 cycles per min (cpm), where as it was 49.2 - 9.3 cpm after blood transfusion. There was reduction in respiratory rate by 1.9 - 4.0 cpm after blood transfusion, which was statistically significant (p < 0.05).

Table 18 : Effect of blood transfusion on SPO$_2$

	Before Blood. transfusion	After Blood. transfusion	Difference
Mean - SD	92.1 - 4.4%	94.9 - 2.8%	2.8 - 3.4%
Range	80 – 99%	88 – 99%	
			t* = 4.35 p < 0.01, Sig

Mean SPO$_2$ before blood transfusion was 92.1 - 4.4%, with a range of 80 – 99%.This was 94.9 - 2.8% with a range of 88 – 99% after blood transfusion. There was increment of 2.8 - 3.4% after blood transfusion. This difference was statistically significant (p < 0.01).

Table 19 : Duration of stay in NICU

Duration of stay (in days)	Frequency	Percentage
1 – 7	19	30
8 – 14	24	38
15 - 21	14	22
22 – 28	1	1.6
> 28	4	6.4

24 (38%) neonates out of 62 needed admission for 8-14 days. 19(30%) babies stayed in NICU for 1- 7 days. 14(22%) babies admitted for a period of 15 – 21 days. 4(6.4%) babies admitted for more than 28 days.

Table 20: Gestational age and immediate outcome

Gest. age (in weeks)	Immediate Outcome	Frequency	Percentage
< 37	Satisfactory	10	47.6
	Not satisfactory	11	52.4
	Total	21	100

> 37	Satisfactory	28	68.3
	Not satisfactory	13	31.7
	Total	41	100
			X² = 2.50 p > 0.05, NS

Preterm babies with satisfactory immediate outcome was seen in 10(47.6%) of the cases, and it was not satisfactory in 11(52.4%) cases. Term babies had satisfactory outcome in 28(68.3%) cases where as it was not satisfactory in 13(31.7%) cases. However the difference was not statistically significant (p > 0.05).

Table 21 : Gestational age and neurodevelopmental outcome

Gest. age (in weeks)	Outcome	Frequency	Percentage
< 37	Good	0	0
	Fair	9	42.9
	Poor	9	42.9
	Expired	3	14.3
> 37	Good	25	65.7
	Fair	4	10.5
	Poor	8	21.0
	Expired	1	2.6

In preterm babies, neurodevelopmental outcome was fair in 9(42.9%), poor in 9(42.9%) and expired in 3(14.3%) cases. In term babies good outcome was seen in 25(52.6%), fair in 4(10.5%), poor in 8(21%) and expired in 1(2.6%) cases.

Table 22 : Septicemia and anemia with immediate outcome

Immediate outcome	Frequency	Percentage
Not satisfactory	15	45.4
Satisfactory	18	54.6
Total	33	100

Immediate outcome was satisfactory in 18(54.6%) of anemic neonates withsepticemia and not satisfactory in 15(45.4%) neonates.

Table 23 : Anemia with septicemia and neurodevelopmental outcome

Outcome	Frequency	Percentage
Good	16	48.4
Fair	6	18.2
Poor	9	27.2
Expired	2	6
Total	33	100

Neurodevelopmental outcome in septicemia with anemia was good in 16(48.4%) cases fair in 6(18.2%), poor in 9(27.2%) and expired in 2(6%) cases.
Immediate outcome was satisfactory in 4(80%) cases of Rh incompatibility, and 1(20%) had not satisfactory immediate outcome. Outcome was good and fair in 3(60%) and 2(40%) cases.
Immediate outcome was satisfactory in 2(100%) cases of ABO incompatibilityand outcome was fair in 1(50%) and poor in 1(50%) cases.
Immediate outcome was satisfactory in 2(67.7%) cases of VKDB and not satisfactory in 1(33.3%). Outcome was good, fair, poor in 33.3% of cases each.
Immediate outcome was not satisfactory in 2(100%) cases of ICH and outcome was poor in all the cases.
Immediate outcome was satisfactory in 1(11.11%) of cases of mechanically ventilated babies and was not satisfactory in 8(88.88%) of cases.
Outcome of was good, poor, expired in 22.22%, 55.55%, and 22.22% of cases respectively.

Table 24 : Mortality analysis

Diagnosis	Frequency	Percentage
Preterm baby with intrapulmonary hemorrhage	1	25
Perinatal asphyxia with septicemia	1	25
Preterm baby with septicemia with CHD	1	25
Preterm baby with HMD	1	25
Total	4	100

Among those who died, prematurity was seen in 3(75%) of the cases.
Septicemia was seen in 2(50%) of the cases, and CHD was seen in 1(25%) case.

Table 25 : Overall immediate outcome in anemic infants

Outcome	Frequency	Percentage
Satisfactory	37	59.7
Not satisfactory	25	40.3

Overall immediate outcome was satisfactory in 37(59.7%) cases and it was notsatisfactory 25(40.3%) cases.

Table 26 : Overall neurodevelopmental outcome in anemic infants

Outcome	Frequency	Percentage
Good	25	42.3
Fair	13	22
Poor	17	28.9
Expired	4	6.7

Overall neurodevelopmental outcome at 6 months of age was good in 25(42.3%), fair in 13(22%), poor in 17(28.9%) and expired in 4(6.7%) cases.

Table 27 : Average Hemoglobin level of infants during their first 6 months of life

Age	Average Hb level (in gm%)
At admission	11.6
1 month	11.2
2 months	10.2
3 months	9.7
4 months	10
5 months	10.1
6 months	10.3

Average Hb at admission was 11.6 g,%, 11.2 gm% at 1 month, 10.2gm% at 2 month, 9.7 gm% at 3 months, 10.gm% at 4 months, 10.1 gm% at 5 months and at the end of 6 months it was 10.3 gm%.

Discussion

In neonates admitted to hospital, the most common cause of anemia is blood loss secondary to iatrogenic blood letting[1]. Anemia in infants is known to be associated with lower motor and mental scores in infancy[8].

Predisposing factors for anemia in newborn

In our study, the hemoglobin level of babies born to anemic and non anemic mothers were 11.4 ± 3.0gm% and 11.9 ± 3.2gm% respectively. Although the levels were in on lower side in babies born to anemic mothers, this difference was not statistically significant at birth (p > 0.05).

This study is in agreement with the studies,[9] which found no correlation between maternal and cord blood Hb levels. This may be because, anemic mothers with reasonably maintained ferritin and transferrin saturation levels provide a sufficient iron for maintenance of cord Hb, although fetal iron stores are likely to be depleted[10].

However our study showed significantly lower levels of Hb at 6 months of age in babies born to anemic mothers (p < 0.05). This is in accordance with the study conducted by Kilbride et al[11] who concluded that infants born to anemic mothers are at increased risk of developing iron deficiency anemia in infancy, which is undetected at birth.

Delayed cord damping

Our study did not show any significant difference in hemoglobin levels between early cord clamping (< 30 sec) or delayed cord clamping. This is in contrast with the studies conducted by Ultee et al[12] which showed positive correlation between the delayed umbilical cord clamping and the hematologic status of the infant. This may be because, the positive co-relation that is obtained in studies practiced delayed cord clamping at 2 or 3 min.[13]. In our study, although cord clamping was > 30 sec, in no babies it was clamped at 2 or 3 minutes after birth, as early cord clamping is still persisting in majority of the hospitals. One more reason why our study has not shown any difference is that many researchers have used variable time period to label as delayed cord clamping, > 20 sec[14], , > 3 minutes[10].

In our study approximately 63% of the anemic neonates were under 7 days of life. In our study we found that anemia was seen more commonly in male neonates,42(67.7%) of 62 cases were males.

In our study 56.5% of the anemic infants were weighing between 2-2.99 kg than babies weighing less than 2 kg. This difference may be because of the higher proportion of the babies belonging to this weight category 2-2.99 kg, were admitted in NICU during our study period. However we found no association between the birth weight and mean hemoglobin level at admission (p > 0.05).

Etiology

In our study most common cause of anemia in newborn is septicemia which accounted for 53% of the cases, which is in accordance with the observations made by Lokeshwar et al,[4] which observed 20% incidence of anemia due to septicemia. This high incidence of septicemia may be because, ours is tertiary care centre, where in the sick neonates are referred here for further management.

Clinical features

Poor feeding is the commonest symptom found in anemic babies in our study. Which is followed by jaundice, hurried breathing and lethargy. .

Most common signs observed in our study are pallor, icterus, tachypnea, bleeding, increased oxygen requirement, lethargy and tachycardia.

Course in the hospital

37% of the anemic neonates received blood transfusion. Our study showed that, after blood transfusion heart rate dropped from 152.3 ± 10.7 bpm to 144.9 ± 7.9 bpm, with reduction of 7.4 ± 5.9 bpm, which is in accordance with the study conducted by Joshi et al,[15] in which similar observations were made. During the course of stay in the hospital significant iatrogenic blood loss was noted in our study in preterm neonates, although the amounts were small compared to others studies[2]. This is because we follow preventive strategy of reducing blood loss by doing blood sampling only when it is required.

Our study showed that there is decrease in respiratory rate in anemic neonates after they receive blood transfusion. The average respiration before and after blood transfusion were 51.1 ± 10.9 cpm and 49.2 ± 9.3 cpm respectively. There was reduction of 1.9 ± 4.0 respiratory rates.In our study it was showed that average duration of stay of all the anemic neonates was 12.11 days.

Immediate outcome

Immediate outcome in term babies was satisfactory in 68.3% cases, where as it was 47.6% cases in preterm babies. We observed more number of not satisfactory immediate in preterm babies.

Immediate outcome in septicemia and anemia was satisfactory in 54.6% of the cases. Similarly it was satisfactory in 80% and 100% of

the cases in Rh and ABO incompatibility respectively.

Immediate outcome was satisfactory 67.7% of the cases in VKDB and were no satisfactory in 33.3% of cases. Both the cases of ICH had not satisfactory outcome. Anemic infants who were put on mechanical ventilation, in them satisfactory outcome was seen only in 11.11% remaining 88.88% had not satisfactory immediate outcome.

Overall immediate outcome of anemic neonates was satisfactory in 59.7% cases and was not satisfactory in 40.3% cases.

Neurodevelopment outcome at 6 months of age

Outcome of anemia with septicemia was good, fair, poor and expired wereseen in 48%, 18%, 27%, and 6% respectively.

Outcome measures good, fair, poor, expired in preterm and term babies was0%, 43%, 43%, 14% and 20%, 4%, 8%, 1% respectively.

In our study, good and fair outcome in Rh incompatibility was seen in 60% and 40% respectively. Outcome in ABO incompatibility was fair and poor in 50% each. In our study, anemia in VKDB showed good, fair, poor neurodevelopmental outcome 33.3% each.

Our study showed poor neurodevelopmental outcome in all cases with intracranial hemorrhage.

Our study showed overall good outcome in 42.3%, fair in 22%, poor in 28.8% and expired in 6.7% of anemic infants. Among those who expired, prematurity was seen in 75%, septicemia in 50%, CHD in 25% of the cases. In our study average Hb level of all admitted babies was 11.6 gm%, which continued to fall till 12 weeks when it reached nadir at 9.7 gm%. The average Hb that was found at 6 month of age was 10.3 gm%.

Conclusion

Hence it can be concluded that anemia in newborn is a common neonatal hematological problem among our NICU admissions. Septicemia is its most important and most common cause. Various maternal and neonatal factors can be associated with anemia. Poor outcome both immediate and short term are observed with anemia at presentation. However, more studies are needed in this regard to generalize these statements and apply to all neonatal admissions.

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